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09/978,118

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## New claims 15-24

- 1. A method for communicating information symbols in a Direct Sequence: Code Division Multiplex communication system (DS-CDMA) including a base of the effort transmitting a signal including multiple information symbols destined for multiple mobile users simultaneously over a single channel having a channel response, sale method comprising:
- a) generating a pilot sequence for synchronizing communication between sold base and said mobile users and transmitting said pilot signal with said signal over the channel for receipt by a receiver device at each said multiple mobile users.
- b) providing at each user receiver device, an adaptive chip equalizer capalities of tracking said channel response;
- c) adapting one or more equalizer taps of said adaptive chip equalizer to ecceived pilot signal at each said receiver device, said adapting for minimizing receiver information symbol errors; and
- e) despreading said signal using a chipping sequence associated with that the consertor extract the information symbols for that user from said single channel.

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3. The method for communicating information symbols as claimed in Claim 2, wherein as power for a transmitted pilot signal increases, a power transmitted to the mobile user decreases for the same total transmitted power.

- 4. The method for communicating information symbols as claimed in communicating information symbols as claimed in communicating the step a) includes generating a plurality of pilot sequences each having known chipping sequence and transmitting said plurality of pilot signals simulated something of the country with said signal over said single channel, said step c) including adapting of the country country to be considered and provided the country of th
- 5. The method for communicating information symbols as claimed in the 1994, wherein said adapting step c) is performed at a greater speed using when adapting adiabative chip equalizer based on said received plurality of pilot signals as communication when adapting based upon a single pilot signal, whereby said plurality of the efficient tracking of fast varying channels.
- 6. The method for communicating information symbols as claimed it. 1, wherein said pilot signal is transmitted continuously, said method thus enables through the continuous equalizer adaptation.
- 7. A Direct Sequence- Code Division Multiplex (DS-CDMA) conti... in system comprising:

a base station for transmitting a signal including multiple information of the destined for multiple mobile users simultaneously over a single channel having the transmitting a signal including multiple information of the destined for multiple mobile users simultaneously over a single channel having the transmitting a signal including multiple information of the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users simultaneously over a single channel having the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multiple mobile users and the destined for multiple mobile users are destined for multi

mechanism for generating a pilot sequence having known chipping sees and transmitting said pilot signal with said signal over said single channel appropriate receiver device at each said multiple mobile users;

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an adaptive chip equalizer provided at each user receiver device capable of tracking said channel response;

mechanism for adapting one or more equalizer taps of said adaptive circle equalizer using said received pilot signal at each said receiver device, said adapting for administring received symbol errors, wherein said receiver de-spreads said signal and gracehipping sequence associated with that mobile user to extract the information and action that user from said single channel.

- 8. The DS-CDMA system as claimed in Claim 7, wherein a power for the signal is equal to the power transmitted for each user.
- 9. The DS-CDMA system as claimed in Claim 8, wherein as power the transmitted pilot signal increases, a power transmitted for each mobile user decreed to the same total transmitted power.
- 10. The DS-CDMA system as claimed in Claim 7, wherein said base to an includes means for generating a plurality of pilot sequences each having a known exping sequence and transmitting said plurality of pilot signals simultaneously said signal over said single channel, said mechanism for adapting one or more company of said adaptive chip equalizer using each said received pilot signals.
- 11. The DS-CDMA system as claimed in Claim 10, wherein said adminished executes at a greater speed using when adapting said adaptive chip echip sechanism based on said received plurality of pilot signals as compared to when adaptine in the single pilot signal, whereby said plurality of pilots enable efficient tracking in the raying channels.
- 12. The DS-CDMA system as claimed in Claim 7, wherein said pilot is transmitted continuously, said method thus enabling continuous equal transmitted continuously, said method thus enabling continuous equal transmitted continuously, said method thus enabling continuous equal transmitted.

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13. A method for adapting chip equalizers used for receiving symbols a rapidly fading channels, said method comprising:

- a) generating a plurality of pilot sequences each having a known chipmen sequence;
- b) transmitting said plurality of pilot signals simultaneously with a signal including multiple information symbols comprising data sequences destined for the le mobile users simultaneously over a single channel.
- c) providing at each user receiver device, an adaptive chip equalizer  $c_0 = \pm t_0$  of tracking a channel response, and obtaining an equalizer output capable of being  $c_0 = \pm t_0$  and to obtain a data sequence for a particular user;
- d) adapting one or more equalizer taps of said adaptive chip equalizer of said received pilot signals at said receiver device, said adapting for minimizing received an information symbol errors; and
- 14. The method as claimed in Claim 13, wherein said adapting step d) as the implementing a least squares method comprising steps of:

generating a vector  $\underline{a}_{R_{\pi}}$  of known transmitted pilot information sym!

generating a matrix C of pilot spreading sequences; and,

estimating said equalizer taps  $f_{N_p}$  according to:

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$$\int_{N_e} = (X^T X)^{-1} X^T \underline{a}_{N_e} \text{ where } X = CR$$

and where  $R(i,j) = r(i + d_f - j) i = 0, \dots, N_s, j = 0, \dots, L_f - 1$ 

with  $N_s$  being the number of received symbols used in estimating the  $e^{i\omega}$  and response; and  $L_f$  is the total number of equalizer taps.

$$\frac{1}{2} \int_{N_r} = (X^T X)^{-1} X^T \underline{a}_{N_r} \text{ where } X = CR$$

and where  $R(i,j) = r(i + d_{f^-}j) i = 0, \dots N N_s, j = 0, \dots L_{f^-}1$ 

with  $N_s$  being the number of received symbols used in estimating the channel response; and  $L_f$  is the total number of equalizer taps.

a mechanism for generating a pilot seque: maving a chipping sequence; and,

a transmitter device for transmitting sale color signal with said communications signal over sale single channel for receipt by a receiver device at element US010142PRELIM.MAR.SLR 1

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multiple mobile users, said receiver device including an adaptive chip equalizer capable of tracking said channel response and adapting one or more equalizer caps of said adaptive chip equalizer using said received pilor signal, said adapting for minimizing received symbol errors;

wherein said receiver device de-spreads said communications signal using a chipping sequence associated with that mobile user to extract the information symbols for that user from said single channel.

- 16. (New) The apparatus as claimed in Claim is, wherein a power for a transmitted pilot signal is equal to the power transmitted for each user.
- 17. (New) The apparatus as claimed in Claim 16, wherein as power for a transmitted pilot signal increases, a power transmitted for each mobile user decreases for the same total transmitted power.
- 18. (New) The apparatus as claimed in Claim 15, wherein said means for generating a pilot signal further generates a plurality of pilot sequences each having a knewn chipping sequence and transmits said plurality of pilot regnals simultaneously with said communications signal or a said single channel, said mechanism for adapting one or more equalizer taps of said adaptive chip equalizer using each said received pilot signals.
- 19. (New) The apparatus as claimed in Claim in therein said adapting mechanism executes at a greater split using when adapting said adaptive chip equalizer board in said US010142PRELIM.MAR.SLR 2

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Treceived plurality of pilot signals as compared to when adapting based upon a single pilot signal, whereby said plurality of pilots enable efficient tracking to fast varying channels.

- 20. (New) The apparatus as claimed in Claim 15, wherein said pilot signal is transmitted continuously, said receiver device capable of performing continuously adaptation.
- 21. (New) A receiver for a communications symmetric capable of receiving a communications signal including multiple information symbols comprising data sequences meetined for multiple users simultaneously over a single to the having a channel response, said communications signate bluding a pilot signal having a known chipping sequence, and receiver comprising:

an adapting chip equalizer used for simultaneously receiving said communications signal and pile signal and, obtaining an equalizer output; and

a device for de-spreading said equalize: put to obtain a data sequence for a particular user.

22. (New) The receiver according to Claim 21, rein said communications signal includes a plurality of the US010142PRELIM.MAR.SLR 3

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sequences each having a known chipping sequence for transmission simultaneously with said commun: .ons signal over said single channel, said adapting chip .lizer adapting one or more of its equalizer taps t .each said received pilot signal.

23. (New) The receiver according to Claim 27. Therein said adapting chip equalizer operates at a greate. The using when adapting based on said received plural. The pilot signals as compared to when adapting based to the signal, whereby said plurality of pilot. Table efficient tracking of fast varying channels.

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